1. D - Origin of Life

Big Idea 1: The process of evolution drives the diversity and unity of life.

- EU 1.A - Evolution is change in the genetic makeup of a population over time.
- EU 1.B - Organisms are linked by lines of descent from common ancestry.
- EU 1.C - Life continues to evolve within a changing environment.
- EU 1.D - The origin of living systems is explained by natural processes.

EK 1.D.1 - There are several hypotheses about the natural origin of life on Earth, each with supporting scientific evidence

A. Primitive Earth provided inorganic precursors from which organic molecules could have been synthesized
1. Due to the presence of available free energy
2. Due to the absence of a significant quantity of oxygen

B. Inorganic precursors served as monomers (building blocks) for the formation of more complex molecules, including amino acids and nucleotides. [See 4.A.1]

C. The joining of these monomers produced polymers with the ability to replicate, store and transfer information.
1. Sidney Fox
   a. Produced proteinoids (abiotic polypeptides)
   b. Dripped organic monomers on hot sand, clay or rock
2. Thomas Cech
   a. Ribozymes can act as enzymes and self-replicate
   b. RNA appears to be the first genetic material

D. These complex reaction sets could have occurred in solution (organic soup model) or as reactions on solid reactive surfaces. [See 2.B.1]
E. The RNA World hypothesis proposes that RNA could have been the earliest genetic material.
Scientific evidence from many different disciplines supports models of the origin of life.

A. Geological evidence provides support for models of the origin of life on Earth.
   1. Earth formed approximately 4.6 billion years ago (by a)
      a) Anaerobic prokaryotes appear about 3.9 billion years ago
      b) Photosynthetic prokaryotes appear 3.5 billion years ago
      c) Oxygen levels increase (ozone layer)
      d) This evidence provides a plausible range of dates when the origin of life could have occurred.
   2. Chemical experiments have shown that it is possible to form complex organic molecules from inorganic molecules in the absence of life.
      a) Microspheres
         1) Form when proteinoids are mixed with cool water
         2) Surrounded by a selectively permeable membrane
      b) Liposomes
         - Form when phospholipids form a bilayered membrane in water
      c) Coacervates
         - Colloidal drops of polypeptides, nucleic acids and polysaccharides

B. Molecular and genetic evidence from extant and extinct organisms indicates that all organisms on Earth share a common ancestral origin of life.
   1. Scientific evidence includes molecular building blocks that are common to all life forms.
   2. Scientific evidence includes a common genetic code.

Oparin /Haldane (1923)
   A. Ammonia, hydrogen, water vapor, and methane
   B. No Oxygen
   C. Volcanic energy, lightning, and UV radiation could create amino acids.

Stanley Miller & Harold Urey (1953)
   A. Experimented with Oparin’s hypothesis
   B. Created all 20 amino acids, nitrogen bases, and ATP
EK 2.B.1- Cell membranes are selectively permeable due to their structure

A. Cell membranes separate the internal environment of the cell from the external environment.